TRENCH-FORMING APPARATUS AND METHODS

CROSS REFERENCE TO RELATED APPLICATION

Applicant claims priority to U.S. Provisional Application Serial No. 60/426,165, filed November 14, 2002, which is hereby incorporated by reference into the present disclosure.

BACKGROUND

Concrete-lined, covered trenches are used in road, parking lot, tarmac, and manufacturing plant applications. Such trenches typically include a pair of opposed rails that include a grate supporting surface upon which grates may be placed to cover the completed trench. Examples of such trenches are described in U.S. Patent No. 6,220,784, which is hereby incorporated by reference into the present disclosure. That patent discloses trench-forming apparatus which includes opposed, Z-shaped rails that form the edges of the trench and, once the trench has been completed, support removable grates.

Although the trench-forming apparatus disclosed in U.S. Patent No. 6,220,784 works well, they can be expensive to construct. In particular, the Z-shaped rails of the apparatus are expensive to manufacture in that the rails are made of relatively-thick (e.g., 1/4 inch thick) metal members which, in some cases, must be longitudinally bent in two separate places to form the Z-shape.

SUMMARY

Disclosed are trench-forming apparatus and methods. In one embodiment, a trench-forming apparatus includes L-shaped frame rails, and a removable form, wherein the removable form is configured to define an inner trench surface of a completed trench and the frame rails are configured to define top edges of the completed trench.

In another embodiment, a trench-forming apparatus includes frame rails including a horizontal portion that is configured for insertion into a removable form, and a removable form including lateral grooves that are configured to receive frame rails, wherein the frame rails are configured to support the removable form in an excavated trench when the horizontal portions are inserted into the lateral grooves of the removable form.

In a further embodiment, a trench-forming apparatus includes frame rails, removable clips configured to releasably attach to the frame rails, the clips comprising a horizontal portion that is configured for insertion into a removable form, and a removable form including lateral grooves that are configured to receive the clips, wherein the frame rails are configured to support the removable form in an excavated trench using the removable clips when the horizontal portions of the clips are inserted into the lateral grooves of the removable form.

In one embodiment, a method for forming a trench includes inserting frame rails that define upper edges of the trench into a removable form, positioning the frame rails coupled with the removable form in an excavated trench, pouring hardenable

material in a space between the removable form and trench walls, and removing the removable form after the hardenable material has cured to an appropriate degree.

In another embodiment, a method for forming a trench includes connecting frame rails that define upper edges of the trench using removable cross-members, adhering a removable form to the cross-members, positioning the frame rails, removable cross-members, and removable form in an excavated trench, pouring hardenable material in a space between the removable form and trench walls, removing the removable cross-members from the frame rails, and removing the removable form.

In a further embodiment, a method for forming a trench includes connecting frame rails that define upper edges of the trench to removable cross-members to form a trench-forming apparatus, attaching a removable form to the trench-forming apparatus such that the removable cross-members are received by rectangular transverse notches of the removable form, positioning the trench-forming apparatus and removable form in an excavated trench, pouring hardenable material in a space between the removable form and trench walls, removing the removable cross-members from the frame rails, and removing the removable form.

In yet another embodiment, a method for forming a trench includes connecting removable clips to frame rails, attaching a removable form to the frame rails using the removable clips by inserting horizontal portions of the removable clips into lateral grooves of the removable form, positioning the frame rails, removable clips, and removable form in an excavated trench, pouring hardenable material in the interstitial

space between the removable form and trench walls, and removing the removable form.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed trench-forming apparatus and methods can be better understood in relation to the accompanying drawings. Components in the drawings are not necessarily to scale.

Fig. 1 is an exploded perspective view of a first embodiment of a trench-forming apparatus.

Fig. 2 is a perspective view illustrating coupling of a removable form and frame rails shown in Fig. 1.

Fig. 3 is a perspective view illustrating an alternative manner of coupling a removable form and frame rails.

Fig. 4 is a cross-sectional view of the trench-forming apparatus of Fig. 1 positioned in an excavated trench.

Fig. 5 is a cross-sectional view of a trench-forming apparatus formed using the removable form and frame rails of Fig. 3, the apparatus shown positioned in an excavated trench.

Fig. 6 is a cross-sectional view of a completed trench formed using the apparatus of Fig. 1.

Fig. 7 is a cross-sectional view of a completed trench formed using the apparatus shown in Fig. 5.

Fig. 8 is an exploded perspective view of an alternative embodiment of a trench-forming apparatus.

Fig. 9 is a cross-sectional view of the trench-forming apparatus of Fig. 8 positioned in an excavated trench.

Fig. 10 is a perspective view of a first alternative frame rail.

Fig. 11 is a partial cross-sectional view that illustrates frame rails similar to that shown in Fig. 10 coupled to a removable form.

Fig. 12 is a perspective view of a second alternative frame rail.

Fig. 13 is a partial plan view of the frame rail shown in Fig. 12.

Fig. 14 is a partial cross-sectional view that illustrates frame rails similar to that shown in Fig. 12 coupled to a removable form.

Fig. 15 is an end view of a third alternative frame rail.

Fig. 16 is a partial cross-sectional view that illustrates frame rails similar to that shown in Fig. 15 coupled to a removable form.

Fig. 17 is an end view of a fourth alternative frame rail.

Fig. 18 is a partial cross-sectional view that illustrates frame rails similar to that shown in Fig. 17 coupled to a removable form.

Fig. 19 is a perspective view of an alternative removable form.

DETAILED DESCRIPTION

Referring now in more detail to the drawings in which like numerals indicate corresponding parts through the several views, Fig. 1 illustrates a first embodiment of a

trench-forming apparatus 100. The apparatus 100 generally comprises first and second frame rails 102 and 104 and a removable form 106. As is shown in Fig. 1, each frame rail 102, 104 comprises a vertical first portion 108 and a horizontal second portion 110. The vertical portion 108 extends upwardly from the horizontal portion 110 at an approximately right angle so that each rail is L-shaped in cross-section. Due to that configuration, the frame rails 102, 104 may be termed L-shaped frame rails. Because an L-shape is used instead of the Z-shape of the prior art, the frame rails 102, 104 may be manufactured less expensively that Z-shaped rails.

The frame rails 102, 104 are constructed of a rigid material such as metal or plastic and may be, for instance, 1/4 inch thick. Preferably, the rigid material is galvanized, painted, or unpainted steel, cast or extruded aluminum, or cast iron. The horizontal portion 110 of each frame rail 102, 104 is provided with a plurality of openings 112 (only visible in rail 102 in Fig. 1), the purpose for which being described below. Each opening 112 extends through the horizontal portions 110 so as to pass completely through the frame rail 102, 104. Optionally, the openings 112 are arranged in pairs along the length of the horizontal portions 110.

Attached to each frame rail 102, 104 are fixation members 114. As indicated in Fig. 1, each of these fixation members 114 is positioned incrementally along the length of the frame rails 102, 104 and extends outwardly therefrom. As is described below, the fixation members 114 hold the rails 102, 104 in place once the trench is completed. In the embodiment of Fig. 1, the fixation members 114 comprise rods, such as stabilizer struts, that are welded to the frame rails 102, 104.

As is further indicated in Fig. 1, the removable form 106 is an elongated member that comprises a top surface 116 and a bottom surface 118. The top surface 116 is typically flat and the bottom surface 118 is U-shaped, although the shape of the bottom surface can be varied to produce any desired trench shape. Accordingly, the bottom surface alternatively can be, for example, square-shaped, V-shaped, or some other geometric shape. By way of example, the removable form 106 is composed of expanded polystyrene (EPS) and, optionally, comprises two integral but separable sections including an inner core 120 and an outer shell 122 that are defined by internal score lines 123. The material and construction described above facilitates removal of the removable form 116 after hardenable material, such as cement, has been poured into an excavated trench and has cured. In that it may be desirable to have a sloped trench bottom to facilitate liquid drainage, the bottom surface 118 of the form 106 may be sloped relative to the top surface 116 as indicated in Fig. 1. Such a result can be achieved, however, with other means (see, e.g., Fig. 19). In the embodiment of Fig. 1, the removable form 108 further includes lateral grooves 124 that are configured to receive the frame rails 102, 104, and rectangular transverse notches 126 that are configured to receive removable cross members (described below). The grooves and the notches can either be formed during form fabrication, or on site as required to accommodate the apparatus being used to form a completed trench. As is indicated in Fig. 1, the tops of the lateral grooves 126 and the bottoms of the transverse notches 126 may be aligned with each other.

In addition to the frame rails 102, 104 and the removable form 106, the trench-forming apparatus 100 includes removable cross-members 128 that maintain proper separation between the first and second frame rails 102 and 104 during trench completion. In the embodiment of Fig. 1, each cross-member 128 comprises a flat piece of rigid material, such as metal or plastic, and is provided with openings 130. In cases in which greater rigidity is desired, the cross-members 128 may comprise angle members similar in configuration to the L-shaped frame rails 102, 104, or other suitably-configured members. Some openings 130 of the cross-members 128 are positioned so as to align with openings 112 of the frame rails 102, 104 when the cross-members are placed on the horizontal portions 110 of the rails when the apparatus 100 is fully assembled in preparation for completing the trench. In particular, the cross-members 128 are releasably secured in place atop the frame rails 102, 104 with fasteners 132, such as threaded bolts that are configured for receipt by threaded nuts 134.

Further illustrated in Fig. 1 are suspension members 136 that are configured to suspend the rails 102, 104 and the removable form 106 within an excavated trench for purposes of pouring hardenable material around the form. As shown in Fig. 1, each suspension member 136 may comprise an elongated angle member that includes a vertical portion 138 and a horizontal portion 140. The horizontal portions 140 are provided with openings 142 that are positioned so as to align with openings 130 of the cross-members 128 to facilitate connection of the suspension members 136 to the cross-members with fasteners 144 to suspend the rails 102, 104 and the form 106. By way of example, the fasteners 144 comprise threaded bolts that are received by threaded nuts

146. Although suspension members 136 are shown in Fig. 1 and have been described herein, other means can be used to support the apparatus within an excavated trench while the trench is being completed. For instance, support brackets (not shown) and support rods (not shown) disposed within the excavated trench could be used to support the trench-forming apparatus 100 in the manner described in U.S. Patent No. 6,220,784.

Fig. 2 illustrates coupling of the frame rails 102, 104 and the removable form 106 using the cross-members 128. As is illustrated in Fig. 2, the horizontal portions 110 of the frame rails 102, 104 are partially inserted into the lateral grooves 124 of the removable form 106 so as to hold the removable form in place relative to the rails and, therefore, the top edges of the completed trench. The relative positions of the frame rails 102, 104 are maintained by the cross-members 128, which are secured to the frame rails with the fasteners 132. As indicated in Fig. 2, the cross-members 128 are received by the rectangular transverse notches 126 of the removable form 106. That receipt or nesting of the cross-members 128 reduces shifting of the removable form 106 when hardenable material is poured into the excavated trench and, therefore, improves the precision with which the trench is formed. Although the frame rails 102, 104 are shown inserted into the lateral grooves 124, the frame rails can, alternatively, be simply urged inwardly against the outer surface of the form 106 using the cross-members 128 so as to support the form by friction fit. In such a case, lateral grooves are not necessary, and the nesting of the cross-members 128 within the transverse notches 126 maintains the form 124 in the correct orientation when positioned in an excavated trench.

Fig. 3 illustrates an alternative manner of coupling the frame rails 102, 104 and a removable form 300. As shown in Fig. 3, the frame rails 102, 104 have the same configurations described above in relation to Fig. 1. The removable form 300, however, neither has lateral grooves nor transverse notches. In such an arrangement, the horizontal portions 110 of the frame rails 102, 104 are aligned with the top surface 302 of the removable form 300 and the form is secured to the cross-members 128 attached to the rails using a suitable attachment mechanism, such as adhesive or double-sided tape (not visible in Fig. 3), which is provided on the bottom surfaces of the cross-members.

Fig. 4 depicts the trench-forming apparatus 100 of Fig. 1 in a fully-assembled state. More particularly, the trench-forming apparatus 100 is shown positioned within an excavated trench 400 that extends through a hard surface 402, such as a concrete or asphalt surface. As is apparent from Fig. 4, the fully-assembled state is achieved by inserting the horizontal portions 110 of the frame rails 102, 104 into the lateral grooves 124 of the removable form 106 and securing the rails using the cross-members 128. The cross-members 128 mount to the frame rails 102, 104 using the fasteners 132. As identified above, the cross-members 128 are received in the rectangular transverse notches 126 that have been provided in the removable form 106. Optionally, the locations of the openings 112 in the frame rails 102, 104 and the openings 130 of the cross-members 128 can be selected such that the frame rails 102, 104 squeeze inwardly on the removable form 106 when the fasteners 132 are tightened to more securely hold the form in place.

Prior to mounting the cross-members 128, the fasteners 144 may be passed through the cross-members such that the threaded ends of those fasteners extend upward from the cross-members. Such placement of the fasteners 144 permits the fasteners, and therefore the cross-members 128 and the remainder of the apparatus 100, to attach to the suspension members 136. When cross-members 128 are attached to the suspension members 136 and the apparatus 100 is positioned within the excavated trench 400, the suspension members suspend the removable form 106 in place through their contact with the hard surface 402. As noted above, the apparatus 100 can, alternatively, be held in place using support members and support rods that are placed within the excavated trench, if desired. Moreover, as noted above, the frame rails 102, 104 may be simply urged inwardly against the outer surface of the form 106 instead of being inserted into lateral grooves. In such a case, the frame rails 102, 104 abut the form similar to the abutment shown in Fig. 3.

Fig. 5 depicts a trench-forming apparatus 500 that comprises the frame rails 102, 104 and the removable form 300 shown in Fig. 3. The fully-assembled state shown in Fig. 5 is achieved in similar manner to that illustrated in Fig. 4. Accordingly, the cross-members 128 mount to the frame rails 102, 104 using the fasteners 132 and are attached to the suspension members 136 with the fasteners 144. However, in that the removable form 300 does not comprise lateral grooves or transverse notches, the horizontal portions 110 of the frame rails 102, 104 are not inserted into the form and the cross-members 128 are not received in transverse notches at the top of the form. Instead, the horizontal portions 110 of the frame rails 102, 104 are aligned with the top surface 302

of the removable form 300, and the cross-members 128 are placed in contact with the top surface of the form. Despite the absence of the lateral grooves and the transverse notches, the removable form 300 is held securely in place within the excavated trench 400 by a suitable attachment mechanism, such as adhesive or double-sided tape (not visible in Fig. 5) that is provided on the cross-members.

Fig. 6 illustrates a completed trench 600 formed using the trench-forming apparatus 100 (see Fig. 4). As indicated in Fig. 6, hardenable material, such as cement, has been poured into the excavated trench 400 so as to fill the interstitial space between the trench-forming apparatus 100 and the trench walls with a now hardened material 602, such as concrete. As noted above, the positions of the frame rails 102, 104 are fixed due at least in part to the presence of the fixation members 114, which are encased in the hardened material 602.

Once the removable form 106 has been removed (as indicated in Fig. 6), a U-shaped inner trench surface 604 remains (or other shape depending upon the shape of the removable form) that extends up to the frame rails 102, 104. Removal of the form 106 is accomplished after the hardenable material has at least cured to the point at which such removal will not adversely affect the trench surface 604. To do that, the fasteners 132 are first removed so that the cross-members 128, and the fasteners 144, can be removed from the apparatus 100. Once the cross-members 128 and their associated fasteners have been removed, the form 106 is removed by first pulling out the inner core 120, and then removing the outer shell 122 (assuming such separate sections are provided).

The nuts 134, or other elements to which the fasteners 132 coupled, remain within the completed trench 600, encased in the hardened material 602. Adjacent the nuts 134 are openings 606 that remain after removal of the fasteners 132 into which the same or other fasteners may be reintroduced so as to facilitate securing of grates (not shown) to the completed trench 600. Due to the insertion of the horizontal portions 110 of the frame rails 102, 104 into the removable form 106 (see Figs. 2 and 4), lips 608 are formed in the completed trench 600, adjacent the top of the inner trench surface 604, that can also be used to secure grates to the trench. For instance, such grates can be secured with members, similar in configuration to the cross-members 128, that engage the underside of the lips 608 and fasteners, such as bolts, that extend down from the grates and thread into those members.

Fig. 7 illustrates a completed trench 700 formed using the trench-forming apparatus 500 of Fig. 5. As indicated in Fig. 7, hardenable material has been poured into the excavated trench 400 so as to fill the interstitial spaces between the trench-forming apparatus 500 and the trench walls so that now hardened material 702 fills the excavated trench, thereby creating an inner trench surface 704 that is similar to that shown in Fig. 6. Therefore, in similar manner to that described above, the form 300 (Fig. 5) is removed after the cross-members 128 and their associated fasteners have been removed by, for example pulling out an inner core and then removing an outer shell of the form. In the case of the trench shown in Fig. 7, however, no lips are formed by the frame rails 102, 104 because the horizontal portions 110 of the frame rails were not inserted into removable form 300 (see Fig. 5). However, due to the openings 706 that remain after

the fasteners 132 have been removed, grates may be secured to the completed trench 700 using the openings 112 provided in the frame rails 102, 104, if desired.

Fig. 8 illustrates an alternative embodiment of a trench-forming apparatus 800. The apparatus 800 is similar in configuration to the trench-forming apparatus 100 of Fig. 1. Therefore, the apparatus 800 generally comprises first and second frame rails 102 and 104, a removable form 106, and cross-members 128. As shown in Fig. 8, however, no transverse notches have been created in the form 106 and the trench-forming apparatus 800 further includes removable clips 802 that are configured to secure the form 106 during trench completion. The clips 802 are composed of thin, rigid material, such as metal, and comprise a first horizontal portion 804, a vertical portion 806, and a second horizontal portion 808 that, as is described below, is positioned and configured for receipt by the lateral grooves 124 of the removable form 106. The various portions of the clips 802 result in a generally Z-shaped cross-section.

As is further shown in Fig. 8, the first horizontal portion 804 of each removable clip 802 is provided with an opening 810 that is adapted to permit passage of a fastener 132. Therefore, the fasteners 132 may be used to secure the cross-members 128 to the frame rails 102, 104 with the removable clips 802 residing between the cross-members and the rails. Such a configuration is depicted in Fig. 9. As is shown in that figure, the removable clips 802 are held securely in place between the cross-members 128 and the frame rails 102, 104 and extend down therefrom such that the second horizontal portions 808 extend into the lateral grooves 124 of the removable form 106. With such a configuration, the removable clips 802 support the form 106 within the excavated trench

400 for the purpose of completing the trench. After the trench has been completed, the clips 802 can be removed along with the cross-members 128 and the form 106 to provide a result similar to that shown in Fig. 7.

Fig. 10 illustrates a segment of a first alternative frame rail 1000. The frame rail 1000 is constructed of a light gauge, rigid material. By way of example, the frame rail 1000 is constructed of approximately 16 to 10 gauge steel (e.g., 12 gauge steel). As shown in Fig. 10, the frame rail 1000 comprises a first vertical portion 1002, a first horizontal portion 1004, a second vertical portion 1006, and a second horizontal portion 1008. Although formation of those multiple portions may require multiple bends of the rigid material, the cost of producing such bends is not unduly large given that the frame rail 1000 is constructed of a light gauge piece of material.

Openings 1010 are provided in the first horizontal portion 1004 to facilitate securing of cross-members (such as cross-members 128) to the frame rail 1000 and/or to facilitate securing of grates to the completed trench. The second horizontal portion 1008 is positioned and configured for receipt by the lateral grooves 124 of the removable form 106. With such an arrangement, the frame rail 1000 can be used to support the removable form 106 in an excavated trench. Coupling of frame rails 1000 to the removable form 106 is depicted in Fig. 11. As shown in that figure, the first horizontal portions 1004 of the frame rails 1000 align with the top surface 116 of the form 106, and the second horizontal portions 1008 are fully received by the lateral grooves 124.

Fig. 12 illustrates a segment of a second alternative frame rail 1200. The frame rail 1200 is constructed of a light gauge, rigid material. By way of example, the frame

rail 1200 is constructed of approximately 16 to 10 gauge steel (e.g., 12 gauge steel). As shown in Fig. 12, the frame rail 1200 comprises an arcuate portion 1202 that is formed by three distinct sub-portions 1204, 1206, and 1208. Extending from the arcuate portion 1202 is a central portion 1210 from which a horizontal portion 1212 extends. As shown in Figs. 12 and 13, the central portion 1210 includes unitarily-formed fixation tabs 1214 that extend outwardly from the central portion. The fixation tabs 1214 are formed, for example, by punching the tabs out from the frame rail 1200 using a punch press. Such fabrication results in a relatively-inexpensive frame rail that includes fixation means for holding the frame rails in place within the hardened material. As is further shown in Fig. 12, the horizontal portion 1212 includes openings 1216 that facilitate mounting of cross-members and/or grates.

Fig. 14 shows frame rails 1200 similar to that of Fig. 12 coupled with a removable form 106. As shown in that figure, the horizontal portions 1212 of the frame rails 1200 extend into the lateral grooves 124 of the removable form 106 to hold the form in place during trench completion. Due to the insertion of the horizontal portions 1212 into the removable form 106, lips will result (see, e.g., Fig. 6) that can be used to mount grates to the completed trench.

Fig. 15 illustrates a segment of a third alternative frame rail 1500. The frame rail 1500 is again constructed of a light gauge, rigid material. By way of example, the frame rail 1500 is constructed of approximately 16 to 10 gauge steel (e.g., 12 gauge steel). As shown in Fig. 15, the frame rail 1500 is similar in configuration to the frame rail 1200 shown in Fig. 12. Accordingly, the frame rail 1500 comprises an arcuate portion 1502

that includes three distinct sub-portions 1504, 1506, and 1508, central portion 1510 that includes unitarily-formed fixation tabs 1514, and a horizontal portion 1512 that includes openings (not shown). In addition, however, the frame rail 1500 includes a vertical portion 1516 that extends downwardly from the horizontal portion 1512, and a second horizontal portion 1518 that extends inwardly from the vertical portion 1516.

Fig. 16 shows frame rails 1500 similar to that illustrated in Fig. 15 coupled to a removable form 1600. As indicated in Fig. 16, the frame rails 1500 are inserted into relatively-wide lateral grooves 1602 formed in the sides of the removable form 1600. In particular, part of the horizontal portion 1512, the vertical portion 1516, and the second horizontal portion 1518 are received by the lateral grooves 1602. With this configuration, reinforced lips result that are similar to the lips formed by the apparatus 1200, except that hardened material, such as concrete, fills spaces 1604 formed by the horizontal portion 1512, the vertical portion 1516, and the second horizontal portion 1518 to provide reinforcement to the lips. Such reinforcement may facilitate more secure grate mounting.

Fig. 17 illustrates a segment of a fourth alternative frame rail 1700. The frame rail 1700 is again constructed of a light gauge, rigid material. By way of example, the frame rail 1700 is constructed of approximately 16 to 10 gauge steel (e.g., 12 gauge steel). The frame rail 1700 comprises a first generally vertical portion 1702, a horizontal portion 1704, and a second generally vertical portion 1706. The first generally vertical portion 1702 comprises several distinct sub-portions including a first angled portion 1708, a first vertical portion 1710, a second angled portion 1712, a second vertical

portion 1714, and a third angled portion 1716. Extending from the second vertical portion 1714 are unitarily-formed fixation tabs 1718 that, for example, are formed using a punch press.

The second generally vertical portion 1706 also comprises several distinct sub-portions including a first angled portion 1720, a first vertical portion 1722, a second angled portion 1724, a second vertical portion 1726, a third angled portion 1728, a third vertical portion 1730, and a fourth angled portion 1732. Extending from the second vertical portion 1726 are unitarily-formed fixation tabs 1734 that, for example, are formed using a punch press.

Fig. 18 shows frame rails 1700 similar to that illustrated in Fig. 17 coupled to a removable form 1800. As indicated in Fig. 18, the frame rails 1700 are positioned relative to the form 1800 such that the horizontal portions 1704 of the rails align with the top surface 1802 of the form. Although not depicted in Fig. 18, the frame rails 1700 can be urged inwardly into the removable form 1800, for instance during securing of cross-members to the rails, to deform the form and therefore more securely hold the form in place.

Fig. 19 illustrates an alternative removable form 1900 that can be used in any apparatus described in the foregoing and, in particular, any apparatus in which the frame rails are configured for insertion into a form. As shown in Fig. 19, the form 1900 is similar in configuration as other forms disclosed herein. Accordingly, the removable form includes a top surface 1902 and a bottom surface 1904, an inner core 1906, and an outer shell 1908. In addition, the form 1900 includes lateral grooves 1910. The grooves

1910 of the form 1900, however, are angled relative to the top surface 1902 so as to facilitate formation of a sloped trench without requiring the height dimension of the form to vary as a function of its length. The angle formed between the lateral grooves 1910 and the top surface (which may be considered to be a "horizontal" surface) depends upon the angle of slope that is desired for the completed trench. By way of example, however, the lateral grooves 1910 diverge from horizontal at an angle that results in a percent slope of about 0.5 to 2.0 percent. Therefore, use of the form 1900 yields results similar to those achieved when the form 106, which has a varying height, is used.

Because of the angled configuration of the lateral grooves 1910, steps may need to be taken to accommodate the cross-members if they are to be used. For instance, rectangular transverse notches (not shown) similar to those described above may need to be formed in the top surface 1902 of the form 1900. In such a case, those notches may have different depths, particularly if it is desired to place the cross-members in contact with the bottom surfaces of the transverse notches. Notably, however, transverse notches may not be required. For instance, the top of the form 1900 may be cut along the length of the form to emulate the angle of the lateral grooves 1910. No such cutting, or notch formation for that matter, may be necessary, however, if removable clips (see, e.g., Figs. 8 and 9) are used to support the form 1900.